3.0 PROPOSED ACTION AND ALTERNATIVES

3.1 INTRODUCTION

DOE analyzed two cleanup and closure alternatives and the No Action Alternative, in accordance with the Council on Environmental Quality regulations implementing NEPA (40 CFR Parts 1500-1508) and DOE's NEPA implementing regulations (10 CFR Part 1021).

Under **Alternative 1**, DOE is proposing to clean up the remaining ETEC facilities using the existing site-specific cleanup standard of 15mrem/yr. (plus DOE's As Low As Reasonably Achievable – ALARA-principle) for decontamination of radiological facilities and surrounding soils (**Alternative 1**). An annual 15-millirem additional radiation dose to the maximally exposed individual (assumed to be an individual living in a residential setting on Area IV) from all exposure pathways (air, soil, groundwater) equates to an additional theoretical lifetime cancer risk of no more than 3×10^{-4} (3 in 10,000). For perspective, it is estimated that the average individual in the United States receives a dose of about 300 millirem each year from natural sources of radiation.

However, actual exposures generally will be much lower as a result of the application of the "as low as reasonably achievable" (ALARA) principle (*see* additional information in Chapter 3 and Appendix G). Based on post-remediation verification sampling previous cleanups have generally resulted in a 2×10^{-6} level of residual risk. DOE would decontaminate, decommission, and demolish the remaining radiological facilities. DOE would also decommission and demolish the one remaining sodium facility and all of the remaining uncontaminated support buildings for which it is responsible. The ongoing RCRA corrective action program, including groundwater treatment (interim measures), would continue. Other environmental impacts would include 2.5×10^{-3} fatalities as a result of LLW shipments and 6.0×10^{-3} fatalities as a result of emission exhaust from all shipments. DOE would also decommission and demolish the remaining sodium facility and decommission and demolish all of the remaining uncontaminated support buildings for which it is responsible. The SSFL RCRA corrective program (including the ongoing groundwater treatment) would continue. Alternative 1 is DOE's preferred alternative. This alternative is described fully in Section 3.2.

Understanding Scientific Notation

Scientific notation is based on the use of positive and negative powers of 10. A number written in scientific notation is expressed as the product of a number between 1 and 10 and a positive or negative power of 10.

Examples:
5,000 would be written as 5×10^3
0.005 would be written as 5×10^{-3}

In this EA, scientific notation is used to express any number lower than 10^{-2} (0.01).

Under **Alternative 2**, DOE would clean up the ETEC site using a 0.05-millirem standard. A 0.05 mrem exposure would result in an additional theoretical lifetime cancer risk of no more than 1×10^{-6} to the maximally exposed individual over 40 years. Additional environmental impacts of this alternative include 1.4 traffic fatalities and increased release of particulates. As under Alternative 1, DOE would also decommission and demolish the remaining sodium facilities and all of the remaining uncontaminated support buildings for which it is responsible. Ongoing groundwater treatment (interim measures) and the SSFL site-wide RCRA corrective action would continue. The only difference between Alternative 1 and Alternative 2 is the volume of soil that would need to be excavated in order to meet the annual dose rate. As under the preferred alternative, DOE would also decommission and demolish the remaining sodium facility and decommission and demolish all of the remaining uncontaminated support buildings for which it is responsible. The SSFL RCRA corrective program, (including the ongoing groundwater treatment) would continue. This alternative is described fully in Section 3.3.

Under the **No Action Alternative**, DOE would conduct no further cleanup of radiological facilities, soil, or the remaining sodium and other support facilities for which it is responsible. Rather, Rocketdyne, as the owner of the site, would prohibit or control access to contaminated facilities, soil, groundwater, or surface water and would continue groundwater treatment. This alternative is described fully in Section 3.4.

DOE initially considered other alternatives that were screened out because they were not considered to be reasonable. These include (1) cleanup of the entire SSFL, (2) the disposal of all radiological facilities as radioactive waste regardless of contamination levels, (3) cleanup of the site to industrial levels, and (4) cleanup of the site to background levels. These alternatives and the reasons why DOE chose to eliminate them from further consideration are discussed in Section 3.5.

Section 3.6 summarizes the impacts that could occur under each of the alternatives analyzed.

3.2 ALTERNATIVE 1: CLEANUP AND CLOSURE UNDER THE 15 MILLIREM STANDARD (PREFERRED ALTERNATIVE)

Implementation of Alternative 1 would last approximately 5 years. Activities performed under Alternative 1 would involve:

- Decontamination and demolition of the three remaining radiological facilities;
- Remediation of residual soil contamination using an annual 15-millirem additional radiation dose to the maximally exposed individual (assumed to be an individual living in a residential setting on Area IV) from all exposure pathways (air, soil, groundwater).
- Sodium removal from, and demolition of, the SPTF;
- Demolition of all remaining uncontaminated DOE support facilities; and
- A final independent survey, using MARSSIM protocols, of Area IV to verify that the site has been cleaned up to the remediation goal.

Implementation of Alternative 1 is expected to result in the generation of radioactive, hazardous, and nonhazardous debris waste volumes, as indicated in Table 3-1.

Table 3-1. Waste Volumes Generated Under Alternative 1

Waste Type	Waste Volume (cubic meters)[a]
Low-Level Radioactive Waste	**7,500**
Building Decontamination	2,000
Soil Remediation	5,500
• RMHF	5,500 cubic meters
• Building 4059	None expected
• Building 4024	None expected
• Remainder of Area IV	0
Mixed Low-Level Radioactive Waste	**20**
Hazardous Waste	**5**
Nonhazardous Debris Waste (Uncontaminated)	**25,300**

a. To convert cubic meters to cubic feet, multiply by 35.3.

The volume of soil that would need to be remediated in the implementation of Alternative 1 was derived using a 1995 Area IV radiological survey (Rocketdyne 1996), the most recent characterization of all 1.2 square kilometers (290 acres) of Area IV, plus additional soil samples taken in 2000 at the RMHF (internal Boeing data) (*see* Appendix E for a discussion of the soil sampling data). The 149 soil samples taken were assumed to be characteristic of surface soil on Area IV. These soil samples provide a distribution of cesium-137, the primary contaminant of concern (as explained more fully in Chapter 4 and Appendix E). Conservatively assuming that these predominantly surface samples are representative of all Area IV soil down to bedrock, DOE estimated the volume of soil that would need to be excavated to meet the 15-millirem annual dose ETEC standard. Based on this dataset, DOE calculated that some soil remediation would be required for the RMHF, but no soil remediation would be required for Buildings 4024 and 4059 or for the remainder of Area IV because all soil in those areas is already below the 15-millirem goal. For purposes of analysis, DOE assumed that all excavated soil would be managed as LLW and shipped offsite.

3.2.1 Decontamination and Demolition of the Remaining Radiological Facilities and Soil Remediation

As discussed in Section 2.3, the ETEC site has three radiological facilities, consisting of 13 separate radiological buildings. These are the RMHF complex (consisting of nine buildings and a rainwater runoff catch basin), the Systems for Nuclear Auxiliary Power Ground Prototype Test Facility (Buildings 4059 and 4459), and the Systems for Nuclear Auxiliary Power Environmental Test Facility (Building 4024). Building decontamination and decommissioning is conducted in accordance with DOE Order 5400.5 (DOE 1990).

3.2.1.1 Radioactive Materials Handling Facility Complex

The RMHF is a RCRA-permitted facility used for waste management activities. Under Alternative 1, DOE would continue to operate the facility until all radioactive waste was shipped offsite. DOE would then survey the buildings that make up the RMHF complex, decontaminate them as necessary, resurvey the buildings (with verification by ORISE and the California DHS), and demolish them. DOE would package any radioactively contaminated RMHF debris and ship it offsite for disposal at a DOE-approved site. Contaminated material in the drainage channel and holding pond would also be removed, packaged, and shipped offsite. Soil remediation would begin after the building debris was removed from the area.

Decontamination and Demolition

Decontamination of the RMHF complex is expected to involve conducting initial radiation surveys, installing protective equipment (airlocks, tenting, shielding, temporary ventilation systems), removing contaminated materials and equipment, decontaminating external services, conducting final and verification surveys, and packaging waste for shipment.

LLW and very small amounts of MLLW would be generated as a result of these activities. In addition to radiological contamination, the RMHF complex may contain hazardous materials such as lead-based paint, asbestos insulation, polychlorinated biphenyl (PCB) light fixture ballasts, solvents, oils, and greases. These would be removed and disposed of as hazardous waste in accordance with all applicable requirements, including the Toxic Substances Control Act and the Ventura County Air Pollution Control District's asbestos management rules (Ventura County 1992).

After radiological contamination was removed, DOE would remove other components, segregate materials, and dispose of the materials. These components would include such support systems as wiring,

> **As Low As Reasonably Achievable**
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> DOE regulations define ALARA as "the approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations" (10 CFR 835.2(a)). ALARA is not a dose limit but a process which has the objective of attaining doses as far below applicable limits as is reasonably achievable. All DOE activities are subject to the ALARA principle (10 CFR 835.101(c)). The ALARA principle is incorporated into DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, which is similar to the NRC policy. *See* Appendix G for additional information regarding the implementation of the ALARA process at ETEC.

electrical components, and remaining auxiliary systems components. The facilities would be demolished. Uncontaminated debris would be disposed of in a local municipal sanitary landfill.

Soil Remediation

Following the decontamination and demolition of the RMHF complex, soil surveys would be conducted to determine the level and extent of any radioactive soil contamination in the area. Those areas with contamination above the cleanup goal for this alternative would be excavated, with the resulting material packaged as LLW. Approximately 5,500 cubic meters (194,230 cubic feet) of soil are projected for excavation from around the RMHF with disposal as LLW at a DOE disposal site (*see* Table 3-1). After a verification survey confirmed that the remediation goal had been met, the area would be backfilled with clean soil from an onsite borrow pit and resurfaced or revegetated to match the surrounding area.[5]

As discussed previously, DOE utilizes the ALARA principle (see box above) to minimize radiation doses from its activities, including cleanup activities (10 CFR 835.101(c)). Application of the ALARA principle means that radiation doses for both workers and the public are typically kept lower than their regulatory limits (in the case of alternative 1, below 15 millirem per year).[6] However, for the purpose of this EA, DOE did not factor in the expected reduction in exposure or risk in its analysis of the alternatives. Appendix G provides additional detail regarding how ALARA is used to achieve lower post-remediation levels below regulatory cleanup goals.

3.2.1.2 Building 4059

This building was used for development testing of Systems for Nuclear Auxiliary Power reactors. It has two concrete-shielded vaults in the basement, only one of which housed a reactor. The reactor vault was made radioactive by neutron activation during Systems for Nuclear Auxiliary Power reactor tests. The above grade portion of Building 4059 and portions of the basement were decontaminated and final surveys (including verification surveys of the above grade structure and sampling by the California DHS, EPA, and the ORISE) completed in 1999 (Rocketdyne 1999c; ORISE 2000).

Decontamination and Demolition

All equipment, piping, and tanks in Building 4059 have been removed and surface decontamination, to the standards of DOE Order 5400.5 (leaving a residual dose of less than one millirem), has been completed. The building may contain hazardous materials such as lead-based paint, asbestos insulation,

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[5] The onsite borrow area is located in a small meadow in the southwest corner of Area IV. A total of 50,460 cubic meters (1.8 million cubic feet) are available from this onsite borrow area for all SSFL environmental projects (Grading Permit Modification [Rocketdyne 1999b]).

[6] Post remediation surveys at ETEC have demonstrated a residual risk of less than 2×10^{-5}. *See* Appendix G.

light fixture ballasts containing PCBs, solvents, oils, and greases. These would be removed and recycled or disposed of as hazardous waste in accordance with all applicable requirements, including the Toxic Substances Control Act and the Ventura County Air Pollution Control District's asbestos management rules (Ventura County 1992).

The entire building (and Building 4459, located within the fenceline of Building 4059) would be surveyed and demolished in two phases. In the first phase, DOE would remove all clean portions of the building and would dispose of it in a local municipal sanitary landfill. In the second phase, DOE would remove the activated concrete in the pipe chase room, vacuum equipment room, and the north and south test vaults. DOE would package this material as LLW and ship it to DOE-approved sites for disposal. The building would be demolished and the resulting nonhazardous debris would be removed for disposal.

Soil Remediation

After building demolition and debris removal, the remaining soil would be sampled. If any soil exceeded the 15-millirem annual exposure ETEC standard, it would be excavated using the ALARA approach, and disposed of as LLW at an appropriate offsite disposal facility. However, based on initial surface soil sampling data, DOE does not expect that soil remediation would be required for the area around Building 4059 to achieve the remediation goal for Area IV of the SSFL under Alternative 1. Following verification sampling by the California DHS and the ORISE, the area would be backfilled with uncontaminated soil from an onsite borrow pit and resurfaced or revegetated to match the surrounding area.

3.2.1.3 Building 4024

This facility consists of two concrete-shielded underground vaults that housed the test reactors, an above grade high bay support area, a control room, and engineering and administrative support offices. As in Building 4059, the reactor vaults were made radioactive by neutron activation during Systems for Nuclear Auxiliary Power reactor tests. The shielding concrete in the vaults contains low levels of activation products. Nine equipment storage vaults in the test cell corridor were used to store various pieces of contaminated equipment. A paved yard surrounds the facility where radioactive solid, liquid, and gas storage tanks were once buried but have since been removed.

Decontamination and Demolition

Remediation of Building 4024 is planned for the near future. The building may contain hazardous materials such as lead-based paint, asbestos insulation, light fixture ballasts containing PCBs, solvents, oils, and greases. These would be removed and recycled or disposed of as hazardous waste in accordance with all applicable requirements, including the Toxic Substances Control Act and the Ventura County Air Pollution Control District's asbestos management rules (Ventura County 1992).

The entire building would be surveyed and demolished in two phases. The first phase would remove all uncontaminated debris and dispose of it in a local municipal sanitary landfill. In the second phase, DOE would remove the contaminated portions of the vaults, package the waste as LLW, and ship it to DOE sites for disposal. The building would be demolished and the resulting nonhazardous debris would be removed for disposal.

Soil Remediation

After building demolition and debris removal, the remaining soil would be sampled. If any soil exceeded the 15-millirem annual exposure standard, it would be excavated and shipped as LLW to an appropriate offsite disposal facility. However, based on limited surface soil sampling data, DOE does not believe that soil remediation would be required for the area around Building 4024 to achieve the remediation goal for Area IV of the SSFL under Alternative 1. Following verification sampling by the California DHS and the ORISE, the area would be backfilled with uncontaminated soil from an onsite borrow pit and resurfaced or revegetated to match the surrounding area.

3.2.2 Closure and Demolition of the Sodium Pump Test Facility

With DOE authorization, Rocketdyne had been using this facility under a commercial contract to perform electromagnetic pump testing of sodium. This project was completed in late 2001. No radioactive materials were ever used at this facility.

Closure of the SPTF would begin by removing approximately 197,000 liters (52,000 gallons) of bulk sodium from the facility (Rocketdyne 1998). As with the closure of other sodium buildings, the entire SPTF sodium system and all residual material contained within that system would be classified and managed as "excluded recyclable material" under the California Health and Safety Code.

After the bulk sodium was removed, a sodium heel and a thin film of sodium would remain in the sodium pump tank. Sodium would also remain within the pipe system components. Because this remaining sodium cannot be easily removed and reused (as sodium metal), it would be converted into sodium hydroxide and reused. As with the decontamination of the Sodium Component Test Installation, DOE would use a variation of a water-vapor-nitrogen technique to convert the sodium into sodium hydroxide (Peterson 1999). In this process, subsaturated water vapor carried within a nitrogen steam would be introduced to the sodium. The water would react with the sodium in a controlled manner and produce sodium hydroxide that would be reused offsite.

All of the sodium components and piping would be cleaned to remove the residual sodium. The components would be either (1) size-reduced and cleaned in batches in a reaction chamber; (2) modified, sealed, and moved to the cleaning facility and cleaned as a unit; or (3) prepared and set up for cleaning and cleaned in place. DOE would then perform tests or examine the cleaned piping to verify the removal of the sodium. The remaining metal of the cleaned component would be collected and sent to scrap dealers for recycling.

The SPTF may also contain hazardous materials such as lead-based paint, asbestos insulation, light fixture ballasts containing PCBs, solvents, oils, and greases. These would be removed and recycled or disposed of as hazardous waste in accordance with all applicable requirements, including the Toxic Substances Control Act and the Ventura County Air Pollution Control District's asbestos management rules (Ventura County 1992). After demolition of the building and removal of the debris, the area would be backfilled with clean soil from an onsite borrow pit and resurfaced or revegetated to match the surrounding area. Because the SPTF is not a radiological facility, no radiological release activities would occur.

3.2.3 Demolition of All Remaining Uncontaminated DOE Support Facilities

Approximately 50 other buildings on the ETEC site are uncontaminated support facilities. These facilities include sodium facilities from which the sodium has already been removed and three former radiological facilities that have been released, or are pending release, by DOE (with the concurrence of the California DHS) but not yet demolished (*see* Appendix E for a table showing the status of all ETEC radiological facilities). For purposes of analysis, DOE assumed that all of these buildings would be demolished. However, DOE may abandon a few of these buildings and turn them over to Rocketdyne for reuse.

After removal of any hazardous material such as lead-based paint, asbestos insulation, light fixture ballasts containing PCBs, solvents, oils, and greases, DOE would remove other components, segregate materials, and either recycle or dispose of the materials in a local municipal sanitary landfill in accordance with all applicable requirements, including the Toxic Substances Control Act and the Ventura County Air Pollution Control District's asbestos management rules (Ventura County 1992). Following the demolition of the buildings and removal of the debris, the areas around the buildings would be backfilled with clean soil from an onsite borrow pit and resurfaced or revegetated to match the surrounding area.

3.2.4 Transportation

Implementation of Alternative 1 would involve the offsite truck transportation of LLW, MLLW, hazardous waste, and nonhazardous debris waste generated as a result of decontamination and demolition activities. Sodium would be shipped offsite for reuse.

LLW would be shipped to Nevada Test Site; MLLW would be shipped to Envirocare; hazardous waste would be shipped to a licensed hazardous waste disposal site, and nonhazardous debris waste would be shipped to a local municipal sanitary landfill. Table 3-2 shows the waste shipments that would be required under Alternative 1.

Table 3-2. Offsite Shipments Under Alternative 1

Waste Type	Number of Truck Shipments
LLW	553[a]
MLLW	20
Hazardous Waste	5
Nonhazardous Debris Waste	1,860[a]
Sodium	11[b]

a. The number of truck shipments was calculated by dividing the total volume to be shipped by 13.6, the volume assumed that could be loaded onto one truck.
b. Approximately 18,900 liters (5,000 gallons) of sodium can be transported in one truck shipment. Shipment of 197,000 liters (52,000 gallons) would require 11 shipments.

In addition, there would be approximately 400 truck shipments of uncontaminated soil from the onsite borrow area to the RMHF.

3.3 ALTERNATIVE 2: CLEANUP AND CLOSURE USING A 0.05 MILLIREM STANDARD

Implementation of Alternative 2 would involve the same actions described that were previously discussed under Alternative 1. However, under Alternative 2, a 0.05-millirem cleanup standard would be used to remediate soil. A 0.05 mrem exposure would result in an additional theoretical lifetime cancer risk of no more than 1×10^{-6} to the maximally exposed individual over 40 years. Additional environmental impacts of this alternative include 1.4 traffic fatalities and increased release of particulates. For perspective, it is estimated that the average individual in the United States receives a dose of about 300 millirem each year from natural sources of radiation.

Implementation of this alternative would require significantly more soil to be excavated, including around Building 4024, and shipped offsite than would be required under Alternative 1. Implementation of this alternative would require additional soil remediation at the former ETEC radiological facilities on Area IV that were previously that were previously remediated to the 15-millirem standard (Alternative 1).

Under this alternative, approximately 404,850 cubic meters (14.3 million cubic feet) of soil would need to be excavated in order to meet the remediation goal of a 0.05-millirem annual dose. Table 3-3 indicates the total volumes of radioactive, hazardous, and nonhazardous debris waste that would be generated under Alternative 2. Only the volume of LLW soils differs between Alternatives 1 and 2.

Table 3-3. Waste Volumes Generated Under Alternative 2

Waste Type	Waste Volume (cubic meters)[a]
Low-Level Radioactive Waste	**406,850**[7]
Building Decontamination	2,000
Soil Remediation (0.05 millirem -Standard)	404,850
• RMHF	27,500
• Building 4059	None expected
• Building 4024	9,350
• Remainder of Area IV	368,000
Mixed Low-level Radioactive Waste	**20**
Hazardous Waste	**5**
Nonhazardous Debris Waste (Uncontaminated)	**25,300**

a. To convert cubic meters to cubic feet, multiply by 35.3.

The volume of soil that would need to be remediated in the implementation of Alternative 2 was derived using the same information and assumptions used to evaluate Alternative 1. Based on this dataset, DOE calculated that soil remediation would be required not only for the RMHF, but also for Building 4024 and the remainder of Area IV, including previously remediated areas. For the remainder of Area IV, DOE assumed that 817,600 square meters (200 acres) of Area IV are soil-covered and habitable and that the average soil depth is 3 meters (10 feet). Because the 1995 data show that approximately 15 percent of Area IV may contain radiological contamination in excess of the 0.05-millirem annual exposure goal, approximately 368,000 cubic meters (13 million cubic feet) of soil would need to be excavated.

After a verification survey confirmed that the remediation goal was met, the area would be backfilled with uncontaminated soil and resurfaced or revegetated to match the surrounding area.

Implementation of Alternative 2 would involve the same type of offsite truck transportation of radioactive, hazardous, and nonhazardous debris waste for disposal and sodium for reuse. With the exception of additional soil shipments, the number of shipments required would be the same under Alternatives 1 and 2. Table 3-4 shows the truck shipments that would be required under Alternative 2.

Because there would not be sufficient uncontaminated soil available from the onsite borrow area[8], most of the clean soil would be trucked in from an offsite borrow area. Thus, implementation of this alternative would also require the shipment of approximately 26,000 truckloads of 354,390 cubic meters (12.5 million cubic feet) of uncontaminated soil to the site.

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[7] Most of this soil would meet DOE, DHS, NRC, and EPA cleanup standards and thus would not meet the definition of LLW. Typically, this soil would be disposed of in a municipal solid waste landfill (Class III). To address public concerns, DOE would dispose of this material at a DOE-approved LLW disposal site.

[8] As noted above, only 50,460 cubic meters (1.8 million cubic feet) of clean soil are available from the onsite borrow area for all SSFL environmental projects. Because 404,850 cubic meters (14.3 million cubic feet) of clean soil would be needed, at least 354,390 (12.5 million cubic feet) would need to be brought in from an offsite location.

Table 3-4. Offsite Shipments Under Alternative 2

Waste Type	Number of Truck Shipments
LLW	30,000[a]
MLLW	20
Hazardous Waste	5
Nonhazardous Debris Waste	1,860[a]
Sodium	11[b]

a. The number of truck shipments was calculated by dividing the total volume to be shipped by 13.6, the volume assumed that could be loaded onto one truck.
b. Approximately 18,900 liters (5,000 gallons) of sodium can be transported in one truck shipment. Shipment of 197,000 liters (52,000 gallons) would require 11 shipments.

3.4 NO ACTION ALTERNATIVE: NO FURTHER CLEANUP AND SECURE THE SITE

Under the No Action Alternative, DOE would conduct no further cleanup of ETEC facilities or soil on Area IV. DOE would implement the following institutional controls to protect the public:

- Facility surveillance and maintenance programs would be designed to ensure structural stability, prevent releases of contamination, and safely store any remaining radioactive or hazardous materials.

- Access to groundwater or surface water contamination would be prohibited for the public and controlled for industrial workers. Access to facilities and soil would be prohibited for the public and controlled for industrial workers to reduce exposure and risk.

- Groundwater pump-and-treat activities would continue at the current level of effort, or other mitigation actions, approved by the California Department of Toxic Substances Control, would be taken until there is evidence, verified by the Department, that offsite migration of contaminants in groundwater was no longer possible.

- Maintenance of sediment controls to prevent migration of chemical contaminants in surface water would continue until there was evidence, verified by the Regional Water Quality Control Board, that offsite migration of chemical contaminants in surface water was no longer possible.

All contaminated and uncontaminated structures would remain in place. None of the radiological or hazardous contamination remaining in or near the facilities would be removed from the facilities or the site. No radiologically contaminated soil would be removed from Area IV.

The No Action Alternative is presented as a baseline against which the potential impacts of Alternatives 1 and 2 can be compared (*see* 40 CFR 1502.14(d)). This alternative is intended to present the minimum requirements that would protect human health and the environment in the event that more extensive remediation cannot be performed (for example, if adequate funding for remedial actions is not approved by the U.S. Congress). However, as noted in Chapter 1, DOE recognizes its responsibility for the remaining radioactive and chemical contamination at ETEC and is proposing to clean up the site prior to closure. DOE will use this EA, and other appropriate information, to decide the most appropriate cleanup and closure procedure for the radiological contamination and hazardous materials remaining at ETEC, such as sodium.

3.5 ALTERNATIVES SCREENED FROM DETAILED EVALUATION

The following alternatives were initially considered but were eliminated from further study because of technical or jurisdictional considerations. The alternatives analyzed and those eliminated from further study are shown in Table 3-5.

3.5.1 Dispose of All Waste as LLW

Under this alternative, DOE would dispose of all radiologically contaminated buildings as radioactive waste.

DOE screened this alternative from detailed evaluation primarily for reasons of impracticality. Even if all generated waste were assumed to be radiologically contaminated, waste streams sent to a LLW or MLLW facility would still have to be sampled and analyzed to ensure that the facility's waste acceptance criteria were met. Therefore, there would be no cost savings for reduced characterization requirements. Once sampling and analysis were complete, the additional cost to segregate waste streams would be minimal. Segregating the waste also provides opportunities for reuse or recycling some of the uncontaminated building materials subject to DOE approval. In addition, the capacity in existing LLW and MLLW disposal facilities is limited; disposing of large volumes of clean material along with the contaminated portions of building debris would unnecessarily reduce the remaining capacity of these facilities. This could possibly create the need for siting and constructing a new LLW or MLLW landfill. Finally, this alternative would not be consistent with existing policies regarding waste minimization. Accordingly, this alternative was eliminated from further study.

3.5.2 Clean Up to Industrial Standards

The site is currently an industrial site and is expected to remain so for the immediate future. Compared to residential exposure, industrial worker exposure is typically for fewer hours per day, fewer days per year, and fewer years at the site. Exposure pathways such as inhalation of volatile contaminants while showering using a contaminated groundwater source are eliminated. Exposure of children is eliminated. For these reasons, an industrial worker can be exposed to much higher contaminant concentrations than a residential receptor before an accepted level of the typical risk is exceeded. The consideration of the cleanup to industrial standards would not be appropriate where the land may be used for a non-industrial purpose at some point in the future.

Cleanup of remaining contamination to residential levels would ensure that industrial receptors would also be protected. Since the land owner has not determined future plans for the site, cleaning up the site to the industrial standards was eliminated from further study.

Table 3-5. Evaluation and Screening of Alternatives

Alternative	Major Components	Effectiveness	Implementability	Cost	Retained for Detailed Evaluation
1	No Further Action	No additional protection provided.	Straightforward. Most controls already in place. Would require final land-use change to industrial.	Low	Yes (Required as baseline)
2.	Cleanup and closure to 15 millirem plus ALARA - excavation - disposal off-site - D&D of radiological facilities	Protects long-term public health and the environment for long term. Minimizes short-term impact on environment and worker health and safety.	Technically straightforward. Implementability has been demonstrated	Medium	Yes
3	Cleanup and closure to 0.05 millirem - excavation - disposal off-site - D&D of radiological facilities	Protects long-term public health and the environment for long term. Short-term impact on environment and worker health and safety is a concern since significantly greater volumes will be excavated.	Technically complex since excavation will be to bedrock in several places. Volume is sufficiently large that existing storage and transportation capacity may be exceeded. Required transportation for off-site disposal may also exceed capacity of existing access roads.	Very High	Yes
4	Cleanup and Closure to 15 millirem plus ALARA, - Treat all wastes as LLW.	Protects long-term public health and the environment for long term. Minimizes short-term impact on environment and worker health and safety.	Technically straightforward, but inconsistent with existing regulations.	Very High	No
5	Cleanup to Industrial Standards	Minimal additional protection provided.	Straightforward. Most controls already in place. Inconsistent with previous adjacent cleanup actions. Would also require change in planned land use.	Low	No
6	Cleanup to background levels	Protects long-term public health and the environment for long term. Most significant negative impact on short-term effectiveness on environment and worker health and safety since significantly greater volumes will be excavated.	Technically complex since excavation will be to bedrock in several places. Volume is sufficiently large that existing storage and transportation capacity may be exceeded. Required transportation for off-site disposal may also exceed capacity of existing access roads.	Very High	No

3.5.3 Clean Up to Background Levels

Under this alternative, DOE would have removed any trace of detectable contamination resulting from operations at ETEC. This alternative was excluded from detailed evaluation primarily due to impracticality. Because background levels of radiological and chemical constituents in soil vary widely locally, regionally, nationally, and worldwide, there are technical questions regarding determination of background levels. In addition, due to the detection limits of current field survey, sampling, and analysis technology, it is difficult or impossible to detect a small fractional increment of contamination above background levels.

The only way to ensure that cleanup to background levels was accomplished would be to remove all soil on the site down to bedrock and replace it with “clean” backfill, which itself would contain naturally occurring radionuclides. The removed soil would have to be transported to an appropriate disposal site, which could result in transportation accidents and fatalities. On the other hand, the reduction in expected latent cancer fatalities compared to residential cleanup levels would be almost imperceptible. Because remediation to background levels would be impracticable and the additional reduction in risk compared to the alternatives considered would be negligible, this alternative was eliminated from further study.

3.6 SUMMARY OF IMPACTS

Under both Alternative 1 and Alternative 2, DOE would decontaminate, decommission, and demolish radiological facilities and soil surrounding these facilities. Under Alternative 1, DOE would conduct soil remediation activities until exposures were as low as reasonably achievable (ALARA) and not higher than a 15-millirem annual limit. Under Alternative 2, DOE would conduct soil remediation activities until exposures were not higher than a 0.05 millirem annual limit.

Under both alternatives, DOE would also decommission and demolish the remaining sodium facility, after removing the sodium for reuse. Radioactive and hazardous waste would be shipped offsite for disposal; the sodium would be transported offsite for reuse.

The lower cleanup level in Alternative 2 would result in approximately 70 times more soil being excavated under Alternative 2 than would be in Alternative 1 (404,850 cubic meters vs. 5,500 cubic meters respectively). The impacts associated with excavation and disposal are summarized below.

Because soil remediation activities (excavation) require heavy physical labor and use of power equipment, this work can result in industrial hazards such as trips and falls, equipment accidents, tool mishandling, and dropped loads. The incidence of these hazards increases as the number of worker hours increases and can be calculated using standard industrial accident rates (fatalities per worker year).

In addition, decontamination and decommissioning activities require the shipment of materials over public highways, which can result in traffic accidents and fatalities. As with industrial hazards, fatalities due to transportation accidents can be calculated using standard traffic accident rates (fatalities per kilometer traveled). The incidence of traffic accidents, and the potential for fatalities due to traffic accidents, increases as the number of shipments and distances traveled increases.

When compared with Alternative 1, the implementation of Alternative 2 would require a substantially higher number of transportation shipments (approximately 30,000 shipments of contaminated soil offsite and 26,000 shipments of clean soil to the site for revegetation, compared to 553 shipments under Alternative 1). The only difference between Alternative 1 and Alternative 2 is the volume of soil that would need to be excavated in order to meet the annual dose rate. This additional soil remediation and resulting transportation under Alternative 2 is likely to result in increased worker and public fatalities, as compared to Alternative 1. Other environmental impacts would include 1.4 fatalities as a result of shipments and 0.23 fatalities as a result of emission exhaust from all shipments. The completion of activities described in Alternative 2 is expected to produce 744 tons of additional criteria air pollutants and particulate matter over Alternate 1 (see Table 3-6).

Against this projection of fatalities due to industrial hazards and transportation accidents must be balanced the reduction in risk due to the reduction in radiation exposure. Under Alternative 1, the expected latent cancer fatalities in a population of 500 people living on the ETEC site for 40 years following remediation to the 15-millirem annual dose ETEC site-specific standard (not taking ALARA into account) would be 0.15 as a result of residual radiological contamination. Under Alternative 2, the expected latent cancer fatalities in a population of 500 people living on the ETEC site for 40 years following remediation to the 0.05-millirem dose standard would be 0.0005 (5×10^{-4}) as a result of residual contamination. The individual lifetime risk of death from cancer from all causes is approximately 0.23 (1998 data) (CDC 2000). Thus, the cumulative individual risk of incurring cancer from all causes plus the maximum theoretical individual risk of incurring cancer as a result of exposure to residual radiological contamination on Area IV would be 0.2303 for Alternative 1, 0.230001 for Alternative 2, and 0.2317 for the No Action Alternative. See Appendix G for more information on risk.

Table 3-6 summarizes the impacts that could occur for the alternatives analyzed.

Table 3-6. Summary of Impacts

Resource	Unit of Measure	Alternative 1 15-millirem annual dose (5 years)[a] *Preferred Alternative*	Alternative 2 0.05-millirem annual dose (8 years)	No Action Alternative (Perpetuity)
LAND USE (*see* Section 4.1)		Residential use	Residential use	Industrial use
GEOLOGY AND SOILS (*see* Section 4.2)	Residual contamination (40-year exposure)	3×10^{-4} additional lifetime cancer risk	1×10^{-6} additional lifetime cancer risk	1.7×10^{-3} additional lifetime cancer risk
AIR QUALITY (*see* Section 4.3)				
Criteria air pollutants	Tons	39.8 tons of air pollutants released as a result of soil excavation and transportation	756.4 tons of air pollutants released as a result of soil excavation and transportation	No criteria air pollutants released
Particulate matter	Tons	2.0 tons released as a result of soil excavation and transportation	29.5 tons released as a result of soil excavation and transportation	No releases
WATER QUALITY AND WATER RESOURCES (*see* Section 4.4)				
Groundwater		No impact expected	No impact expected	No impact expected
Surface water		No impact expected	No impact expected	No impact expected
Wetlands		No impact expected	No impact expected	No impact expected
Floodplains		No impact expected	No impact expected	No impact expected
RADIOLOGICAL DOSE (*see* Section 4.5)				
Public				
Maximally exposed individual - annual	Millirem	2.8×10^{-3}	2.8×10^{-3}	7.7×10^{-7}
Maximally exposed individual - total	Millirem	1.4×10^{-2}	2.2×10^{-2}	Not applicable
Population – annual	Person-rem	0.11	0.11	2.2×10^{-4}
Population – total	Person-rem	0.56	0.9	Not applicable
Worker				
Average - annual	Millirem	470	470	7
Average - total	Millirem	2,345	3,760	Not applicable
Population – annual	Person-rem	10.3	10.3	0.92
Population – total	Person-rem	52	82	Not applicable

Table 3-6. Summary of Impacts (cont)

Resource	Unit of Measure	Alternative 1 (5 years)[a] *Preferred Alternative*	Alternative 2 (8 years)	No Action Alternative (Perpetuity)
HUMAN HEALTH (*see* Section 4.5)				
Public				
Maximally exposed individual - annual	Probability of latent cancer fatality	1.4×10^{-9}	1.4×10^{-9}	3.9×10^{-13}
Maximally exposed individual - total	Probability of latent cancer fatality	7.0×10^{-9}	1.1×10^{-8}	Not applicable
Population – annual	Latent cancer fatality	5.6×10^{-5}	5.6×10^{-5}	1.1×10^{-7}
Population – total	Latent cancer fatality	2.8×10^{-4}	4.5×10^{-4}	Not applicable
Residual risk following remediation				
Individual living onsite for 40 years	Probability of latent cancer fatality	3×10^{-4}	1×10^{-6}	1.7×10^{-3}
Population (500 people living onsite for 40 years)	Latent cancer fatality	0.15	0.0005	0.85
Total cancer risk to an individual (all causes)[b]	Probability of latent cancer fatality	0.230300	0.230001	0.2317
Worker				
Average - annual	Probability of latent cancer fatality	1.9×10^{-4}	1.9×10^{-4}	2.8×10^{-6}
Average - total	Probability of latent cancer fatality	9.4×10^{-4}	1.5×10^{-3}	Not applicable
Population – annual	Latent cancer fatality	4.1×10^{-3}	4.1×10^{-3}	3.7×10^{-4}
Population – total	Latent cancer fatality	2.1×10^{-2}	3.3×10^{-2}	Not applicable

Table 3-6. Summary of Impacts (cont)

Resource	Unit of Measure	Alternative 1 (5 years) [a] *Preferred Alternative*	Alternative 2 (8 years)	No Action Alternative (Perpetuity)
Facility Accidents				
Industrial (workers)	Fatalities per year	5.2×10^{-3}	6.5×10^{-3}	1.8×10^{-3} (1st year) 1.3×10^{-3} (subsequent years)
Radiological				
Public – maximally exposed individual	Probability of latent cancer fatality	3.5×10^{-6}	3.5×10^{-6}	0
Public - population	Latent cancer fatality	0.5	0.5	0
Worker (100 meters away)	Probability of latent cancer fatality	7.0×10^{-4}	7.0×10^{-4}	0
Sodium		Injury and death could occur in worker population	Injury and death could occur in worker population	None
BIOLOGICAL RESOURCES (*see* Section 4.6)				
Threatened/endangered/sensitive species		No impact expected	Potential impact	No impact expected
Other plants and animals		No impact expected	No impact expected	No impact expected
CULTURAL RESOURCES (*see* Section 4.7)		No impact expected	Potential impact	No impact expected
NOISE AND AESTHETICS (*see* Section 4.8)		No impact expected	Potential impact	No impact expected
SOCIOECONOMICS (*see* Section 4.9)		No impact expected	No impact expected	No impact expected
WASTE MANAGEMENT (*see* Section 4.10)				
LLW generated	Cubic meters	7,500	406,850	0
MLLW generated	Cubic meters	20	20	0
Hazardous waste generated	Cubic meters	5	5	0
Nonhazardous debris waste generated	Cubic meters	25,300	25,300	0

Table 3-6. Summary of Impacts (cont)

Resource	Unit of Measure	Alternative 1 (5 years) [a] *Preferred Alternative*	Alternative 2 (8 years)	No Action Alternative (Perpetuity)
TRANSPORTATION (*see* Section 4.11)				
LLW shipments	Number of truck shipments	553	30,000	0
MLLW shipments	Number of truck shipments	20	20	0
Hazardous waste shipments	Number of truck shipments	5	5	0
Nonhazardous debris waste shipments	Number of truck shipments	1,860	1,860	0
Sodium shipments	Number of truck shipments	11	11	0
Clean backfill shipments	Number of truck shipments	0	26,000	0
Transportation accidents (nonradiological)				
LLW shipments	Fatalities	2.5×10^{-2}	1.4	0
Nonhazardous debris shipments	Fatalities	5.7×10^{-3}	5.7×10^{-3}	0
Emission exhaust (all shipments)	Fatalities	6.0×10^{-3}	0.23	0
ENVIRONMENTAL JUSTICE (*see* Section 4.12)		No impact expected	No impact expected	No impact expected

a. Although application of the ALARA process is component of this alternative, DOE has taken no credit for the expected reduction in exposure or risk in its analysis.

b. The individual lifetime cancer risk of a fatal cancer from all causes is approximately 0.23 (1998 data) (CDC 2000). This represents the cumulative risk of incurring cancer from all causes plus the risk of incurring cancer as a result of exposure to residual radiological contamination on Area IV.

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